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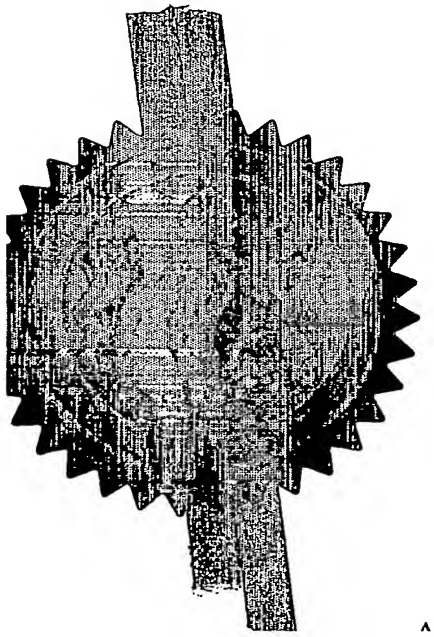

Signed Andrew Gerrey

Dated 2 October 2003

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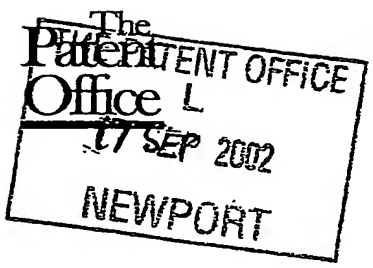

175EP02 E748806-6 D02835
P01/7700 0.00-0221527.5

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1. Your reference — WMO/JAW/P11784

2. Patent application number *(The Patent Office will fill in this part)* — 0221527.5 — 17 SEP 2002

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

DePuy International Limited
St Anthony's Road
Beeston
Leeds, LS11 8DT

Patents ADP number *(if you know it)* 6004733002

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention — Spinal implantation device

5. Name of your agent *(if you have one)* — Urquhart-Dykes & Lord

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Tower House
Merrion Way
Leeds
LS2 8PA

Patents ADP number *(if you know it)* 1644004

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
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Yes

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Continuation sheets of this form	
Description	4
Claim(s)	1 DMC
Abstract	
Drawing(s)	2+2

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Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
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11. I/We request the grant of a patent on the basis of this application.

Signature [signature] Date 16.9.02

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SPINAL IMPLANTATION DEVICE

This invention relates to a spinal implantation device.

The technique of implantation of a spinal implant is generally well known, and will therefore not be described in great detail herein. However, brief description will follow, to serve as background to the development of the present invention.

A spinal implant may take the form of a "shape memory" metal cage, which is introduced into the spine through a minimal access opening (currently posterior approach), and the invention seeks to provide an improved implantation device, or surgical tool which can facilitate what is necessarily a delicate task to be undertaken by the surgeon.

Ease of manipulation of the implant is a very important requirement; also a highly desirable feature of an implantation device is to facilitate easy cleansing and sterilisation after use, given that body fluids can easily enter the interior of any device used for spinal implantation.

According to the invention there is provided a spinal implantation device which comprises:

a guide track for guiding the movement of a spinal implant to an implantation site of a patient;

an elongate implant carrier which is moveable lengthwise of the guide track in order to deliver the implant to the implantation site;.

a driving device engageable with the elongate carrier and operative to apply indexing movement to the carrier; and

a pivotable element which is engageable with the implant, when the latter reaches the implantation site, so as to release the implant from the carrier and allow completion of the implantation.

The invention therefore provides for easy guidance of the implant to the implantation site and upon release of the implant, the surgeon may then manually complete the implantation.

When, as is preferred, the implant is a shape memory cage, this may easily be manipulated so as to complete the implantation.

Preferably, the driving device is a manually operative device and conveniently advancing and reversing movement of the elongate carrier can be carried out by manipulation of finger-operated levers.

In a preferred arrangement, the implant carrier takes the form of a toothed rack, and the driving device may include a ratchet-type of drive pin or the like to engage intermittently with the rack, and thereby cause incremental advance or return movement of the rack as required. However, other drive connections may be provided between the driving device and the toothed rack, including a drive pinion.

Preferably, the driving device has a housing in which the driving components are housed, and the housing may be separable into at least two separate portions to allow easy access to the interior for the purposes of cleaning/sterilisation of the internal components, and the interior of the housing, after surgery.

A preferred embodiment of spinal implantation device according to the invention will now be described in detail, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view from one side of a manually operative driving device, guide track, and implant carrier, in non-assembled form, and forming a spinal implantation device according to the invention for use in delivering a spinal implant to an implantation site of a patient;

Figure 2 is a perspective view, from an opposite side of the housing of the driving device, showing manually operative levers for applying advancing and reversing movement to the implant carrier;

Figure 3 is a perspective illustration, partly in plan view, showing in more detail, the mounting on the driving device on which the guide track and implant carrier can be mounted; and

Figures 4a, b, c and d are separate views of, respectively, the implant carrier, the implant, the implant coupled to one end of the implant carrier, and a pivoted release arrangement at one end of the implant carrier for effecting release of the carrier after the latter has been delivered to the implantation site.

Referring now to the drawings, a spinal implantation device according to the invention is designated generally by reference 10 and comprises a guide track 11 for guiding the movement of the spinal implant to an implantation site of a patient, and an elongate implant carrier 12 which is moveable lengthwise of the guide track 11 in order to deliver the implant to the implantation site, and a driving device 13 which is engageable with the elongate carrier 12 and operative to apply indexing movement to the carrier.

Figure 4 shows separate views of the implant carrier 12, and an implant 14, and how they work together in order to deliver the implant to the required patient site and then effect release of the implant for final completion of the implantation process.

Figure 4c shows the implant 14 coupled to a leading end of the implant carrier 12 and figure 4d shows the implant after release from the carrier, when it has been delivered to the implantation site. There is shown schematically a pivotable element 15, which in the illustrated arrangement is connected to the leading end of the carrier 12 and which engages with the implant 14, when the latter has reached the implantation site, so as to release the implant from the carrier 12 and allow completion of the implantation.

The illustrated embodiment therefore provides for easy guidance of the implant 14 to the implantation site, and upon release of the implant, the surgeon may then manually complete the implantation. When, as is preferred, and shown in Figure 4b, the implant is a curved shape memory cage, this may easily be manipulated so as to complete implantation.

Returning to figures 1 to 3, this shows in more detail the construction and operation of the driving device 13, and which is a manually operated device, in which advancing and reversing movement of the elongate carrier 12 is carried out by manual manipulation of finger operated levers 16 and 17.

The implant carrier 12 preferably takes the form of a toothed rack, as shown, and the driving device 13 may include a ratchet-type of drive pin (not shown in detail) or the like, to engage intermittently with the rack, and thereby cause incremental advance or return movement of the rack as required.

Other drive connections may be provided, to transmit linear reciprocatory movement to the rack 12, including a drive pinion.

The driving device 13 has a two part housing in which the driving components are housed, and which may be separated, by operation of a push button 18, to allow easy access to the interior for the purposes of cleansing/sterilising the internal components after surgery and also the interior of the housing.

CLAIMS

1. A spinal implantation device which comprises:

a guide track (11) for guiding the movement of a spinal implant (14) to an implantation site of a patient;

an elongate implant carrier (12) which is moveable lengthwise of the guide track (11) in order to deliver the implant (14) to the implantation site;

a driving device (13) engageable with the elongate carrier (12) and operative to apply indexing movement to the carrier; and

a pivotable element (15) which is engageable with the implant (14), when the latter reaches the implantation site, so as to release the implant (14) from the carrier (12) and allow completion of the implantation.

2. A spinal implantation device according to claim 1, in which the driving device (13) is a manually operated device.

3. A spinal implantation device according to claim 2, in which advancing and reversing movement of the elongate carrier (12) can be carried out by manipulation of finger operated levers (16,17) mounted on the housing of the device (13).

4. A spinal implantation device according to any one of claims 1 to 3, in which the implant carrier (12) takes the form of a toothed rack, and the driving device (13) includes a drive pin or the like to engage intermittently with the rack (12) and thereby cause incremental advance or return movement of the rack as required.

5. A spinal implantation device according to any one of the preceding claims, in which the driving device (13) has a housing in which the driving components are housed, and the housing is separable into at least two separate portions to allow easy access to the interior for the purposes of cleansing/sterilising of the internal components after surgery, and also the interior of the housing.

These pictures show the metal prototype which is based upon this concept

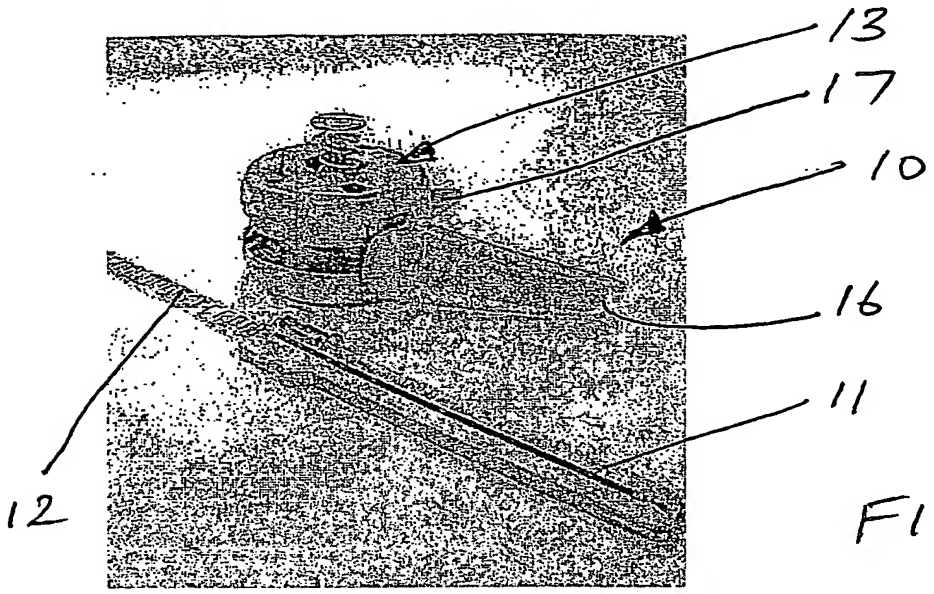

FIG. 1

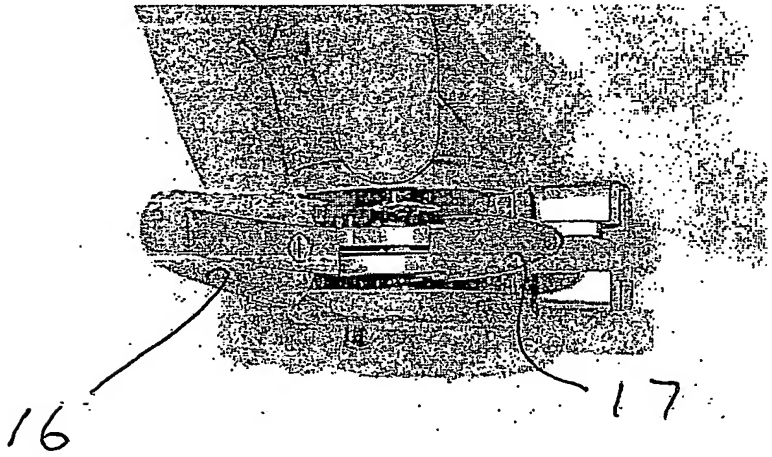

FIG. 2

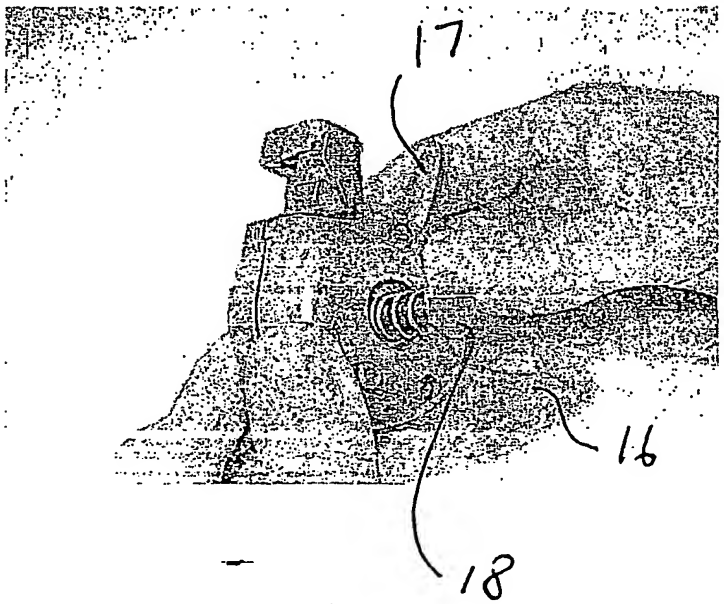

FIG. 3

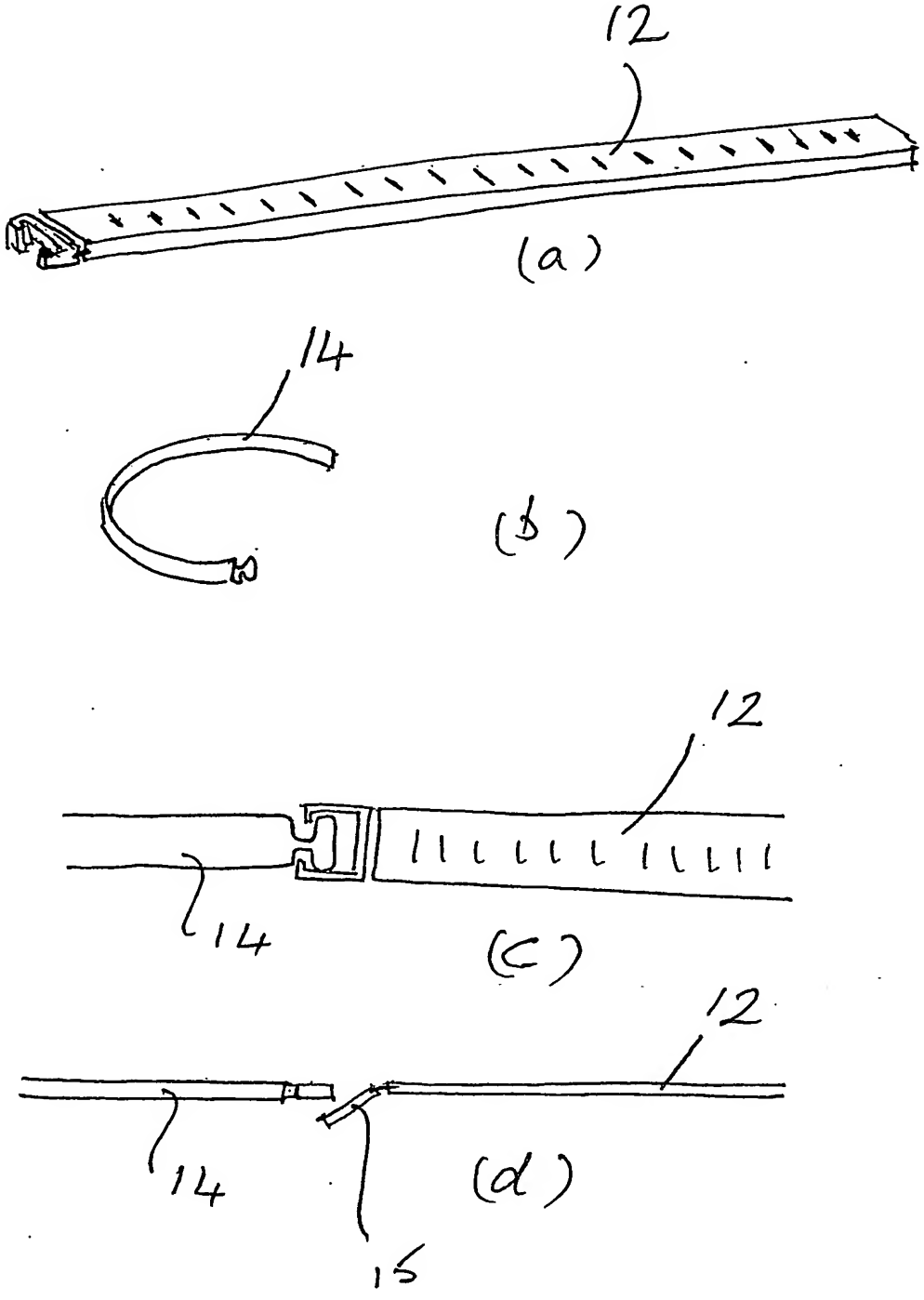

FIG. 4

An advantage of this system over the above-mentioned prior art system is that the system of the invention generates less N_2O by lean NO_x catalysis over the platinum component of the first NO_x-trap.

The at least one second NO_x-absorbent can be associated with a base metal catalyst for oxidising nitrogen monoxide (NO) to nitrogen dioxide (NO_2) in lean exhaust gas or a non-platinum platinum group metal, such as rhodium or iridium, for reducing NO_x to N_2 in rich exhaust gas..

According to a further aspect, the invention provides an exhaust system for a diesel engine, which system comprising a first NO_x-trap comprising at least one first NO_x absorbent and platinum, characterised in that a second NO_x-trap is disposed upstream of the first NO_x-trap, which second NO_x-trap comprising at least one second NO_x absorbent and at least one platinum group metal selected from the group consisting of rhodium, palladium, iridium, osmium and ruthenium.

The first NO_x-trap can be coated on a flow-through monolith, but in one embodiment, it is coated on a particulate filter. In a further embodiment according to the latter aspect, the particulate filter can include a diesel oxidation catalyst, optionally comprising supported platinum and/or palladium.

Optionally there may be a catalyst for oxidising NO to NO_2, such as platinum on an alumina support, disposed between the at least one second NO_x absorbent and the first NO_x-trap as described in our WO 02/18753.

During NO_x-trap regeneration, pulses of rich exhaust gas can be produced by the engine to convert stored NO_x to nitrogen. During this process, hydrocarbon or carbon monoxide could pass through the system to atmosphere. To prevent this, the gas downstream of the first NO_x-trap can be passed over an oxidation catalyst comprising an oxygen storage component, so even if the gas is overall reducing, reductants can still be oxidised, and prevented from entering the atmosphere. In one embodiment, the oxidation catalyst comprises platinum or palladium supported on a bulk ceria-zirconia mixed oxide oxygen storage component.

According to a further aspect, the invention provides a diesel engine, optionally a light-duty diesel engine (as defined by the relevant legislation) comprising an exhaust system according to the invention. As is typical for engines including exhaust systems comprising NO_x-traps, the engine can include an engine control unit (ECU) programmed, in use, to adjust the exhaust gas composition to the rich side for regenerating the at least one first NO_x absorbent and the at least one second NO_x absorbent.

According to a further aspect the invention provides a flow through substrate comprising a NO_x-trap comprising a first zone coated with a composition comprising at least one first NO_x absorbent and platinum and a second zone coated with a composition comprising at least one second NO_x-absorbent, which at least one second NO_x absorbent is not associated with platinum.

According to a further aspect the invention provides a flow-through substrate comprising a first zone comprising a first NO_x-trap composition comprising at least one first NO_x absorbent and platinum and a second zone comprising a second NOx-trap composition comprising at least one second NO_x-absorbent and at least one platinum group metal selected from the group consisting of rhodium, palladium, iridium, osmium and ruthenium.

According to a further aspect, the invention provides a method of treating NO_x in the exhaust gas of a diesel engine, which method comprising absorbing NO_2 from lean exhaust gas in at least one second NO_x absorbent; oxidising NO in lean exhaust gas to NO_2 at 300°C and above over a platinum catalyst and absorbing the NO_2 generated from oxidising NO in at least one first NO_x-absorbent; desorbing the stored NO_x in rich exhaust gas and reducing the desorbed NO_x to N_2.

In order that the invention may be more fully understood, reference is made to the sole accompanying drawing which shows a schematic diagram of a diesel engine comprising an exhaust system according to the invention. It is believed that the Figure, as annotated, is self-explanatory.

CLAIMS:

1. An exhaust system for a diesel engine, which system comprising a first NO_x-trap comprising at least one first NO_x absorbent and platinum, characterised in that at least one second NO_x absorbent is disposed upstream of the first NO_x-trap, which at least one second NO_x absorbent is not associated with platinum.

2. An exhaust system according to claim 1, wherein the at least one second NO_x-absorbent comprises a base metal catalyst for oxidising nitrogen monoxide (NO) to nitrogen dioxide (NO_2) in lean exhaust gas.

3. An exhaust system according to claim 1 or 2, wherein the at least one second NO_x-absorbent comprises a non-platinum platinum group metal (PGM) for reducing NO_x to N_2 in rich exhaust gas.

4. An exhaust system according to claim 3, wherein the PGM is rhodium or iridium.

5. An exhaust system for a diesel engine, which system comprising a first NO_x-trap comprising at least one first NO_x absorbent and platinum, characterised in that a second NO_x-trap is disposed upstream of the first NO_x-trap, which second NO_x-trap comprising at least one second NO_x absorbent and at least one platinum group metal selected from the group consisting of rhodium, palladium, iridium, osmium and ruthenium.

6. An exhaust system according to any of claims 1 to 5, wherein the first NO_x-trap comprises a particulate filter.

7. An exhaust system according to claim 6, wherein the particulate filter also includes a diesel oxidation catalyst, optionally comprising supported platinum and/or palladium.

8. An exhaust system according to any preceding claim, further comprising a catalyst for oxidising NO to NO_2 disposed between the at least one second NO_x absorbent and the first NO_x-trap.

9. An exhaust system according to claim 8, wherein the NO oxidation catalyst is platinum on an alumina support.

10. An exhaust system according to any preceding claim, further comprising a catalyst comprising a catalyst component for oxidising hydrocarbon and carbon monoxide to water and carbon dioxide and an oxygen storage component, which catalyst is disposed downstream of the first NO_x-trap.

11. An exhaust system according to claim 10, wherein the oxidation catalyst comprises platinum or palladium supported on a bulk ceria-zirconia mixed oxide oxygen storage component.

12. A diesel engine comprising an exhaust system according to any preceding claim.

13. A light-duty diesel engine according to claim 12.

14. An engine according to claim 12 or 13, comprising an engine control unit programmed, in use, to adjust the exhaust gas composition to the rich side for regenerating the at least one first NO_x absorbent and the at least one second NO_x absorbent.

15. A flow-through substrate comprising a NO_x-trap comprising a first zone coated with a composition comprising at least one first NO_x absorbent and platinum and a second zone coated with a composition comprising at least one second NO_x-absorbent, which at least one second NO_x absorbent is not associated with platinum.

16. A flow-through substrate comprising a first zone comprising a first NO_x-trap composition comprising at least one first NO_x absorbent and platinum and a second zone comprising a second NOx-trap composition comprising at least one second NO_x-absorbent and at least one platinum group metal selected from the group consisting of rhodium, palladium, iridium, osmium and ruthenium.

17. A method of treating NO_x in the exhaust gas of a diesel engine, which method comprising absorbing NO_2 from lean exhaust gas in at least one second NO_x absorbent; oxidising NO in lean exhaust gas to NO_2 at 300°C and above over a platinum catalyst and absorbing the NO_2 generated from oxidising NO in at least one first NO_x-absorbent; desorbing the stored NO_x in rich exhaust gas and reducing the desorbed NO_x to N_2.

18. An exhaust system substantially as described herein with reference to the accompanying drawing.

19. An engine substantially as described herein with reference to the accompanying drawing.

20. A method substantially as described herein.

EXHAUST SYSTEM FOR A DIESEL ENGINE COMPRISING A NO_x-TRAP

Abstract

An exhaust system for a diesel engine comprises a first NO_x-trap comprising at least one first NO_x absorbent and platinum, characterised in that at least one second NO_x absorbent is disposed upstream of the first NO_x-trap, which at least one second NO_x absorbent is not associated with platinum.

[Figure 1]

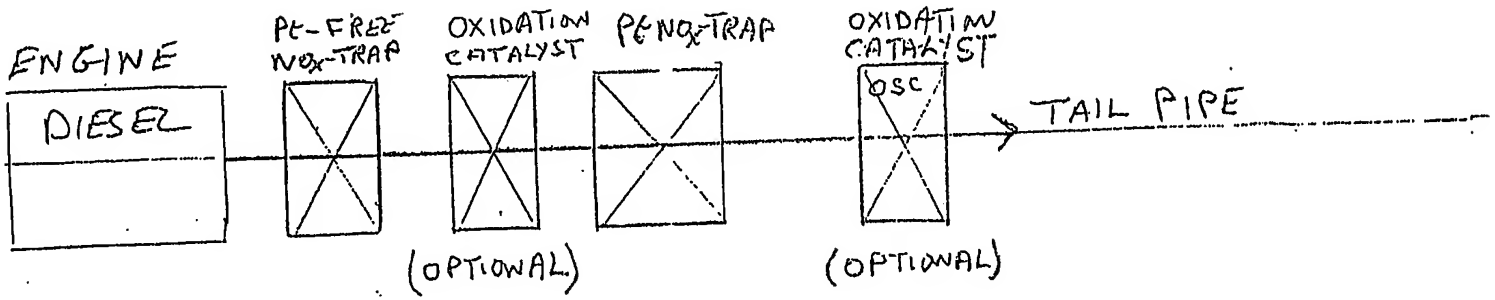
ENGINE
DIESEL
Pt-FREE NOx-TRAP
OXIDATION CATALYST
(OPTIONAL)
Pt NOx-TRAP
OXIDATION CATALYST
OSC
(OPTIONAL)
TAIL PIPE

FIG 1.